

2.—A REVISION OF THE WESTERN AUSTRALIAN SPECIES OF *TRIODIA* R. BR.

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Communicated by C. A. GARDNER.

The revision of the species of this genus in Western Australia was undertaken as a result of investigations concerning the management and carrying capacity of certain natural pastures in the north-west of the State. The investigations were being made by officers of the Institute of Agriculture of the University of Western Australia. The species are all xerophytic grasses with a characteristic tussock habit and pungent pointed leaves. Although the genus is found throughout tropical and arid Australia, it is only in Western Australia that there is a definite pastoral zone dependent on these grasses. The zone, speaking very broadly, is a triangle with its base line along the Ashburton River and its apex at Broome. To the south of this area, the country grades into the mulga zone with *Acacia* spp. as the dominant forms. To the east is desert country where more *Triodia* occurs but, by reason of poor water supplies and general inaccessibility, no leases have been taken up. South of this pastoral zone some species of *Triodia* do occur but they are of no value to the pastoralist.

The name "spinifex" is commonly, but erroneously, attached to these grasses. The word is so widely and so consistently used by pastoralists that it is accepted in some places in this paper to avoid further confusion. Actually the name *Spinifex* belongs to another genus of grasses which, in this part of Australia is commonly found on sand dunes near the coast. Some of the species of *Triodia* have been called "porcupine grass" though not in this State and this name will not be used in this paper.

ECONOMIC VALUE IN WESTERN AUSTRALIA.

By far the most important species is *Triodia pungens* since it is the only one which is readily eaten by sheep. It is also widely distributed throughout the more arid sections of the State which have a predominantly summer rainfall. It is a variable species and edibility is related to the growth form, as well as to the age of the plant. This will be further discussed under the species description. *T. pungens* is tolerant of different soil conditions and it ranges through the whole of the pastoral zone, described above, and extends right across to Queensland. As will be shown it has been collected, by the author, over a considerable area of the pastoral zone and field notes concerning variability are available. So far as edibility is concerned trials carried out at Warralong Station, Coongan River, by officers of the Institute of Agriculture, showed that the digestibility of this species is approximately 50 per cent.

With reference to the ecological association of which *T. pungens* is the dominant species it should be realised that herbage resulting from the growth of annual fodder plants is scanty in most seasons, in comparison with the flush of growth which appears in mulga country. The perennial grasses form a closed community and, except where they are burnt back, there is little ephemeral growth. The practice of burning back the tussocks when

they become old, coarse and unpalatable is used throughout the area. This means that there are odd patches in all paddocks, where a certain amount of herbage is available to the grazing animal. As a general rule this is entirely eaten out by the sheep before they will touch the rough fare offered by the tussock grasses. Top feed is not important in the spinifex areas.

The majority of the rest of the species come under the heading of Buck Spinifex, *i.e.*, very rigid-leaved forms in comparison with *T. pungens* which is commonly called "Soft Spinifex." The value of Buck spinifexes to the pastoralist is very small. In most cases the seedheads are eaten by stock.

Some species regenerate less readily than others. As a whole the spinifex association is an extremely stable one, ecologically. This is a fact of prime importance when the risks of soil erosion as a result of denudation by grazing animals is considered. So far the spinifex plains do not seem to be showing any marked deterioration but along the rivers which serve as stock routes there has been serious depletion as a result of overgrazing or of floods following heavy stocking. However in such habitats the *Triodia* association gives way to a savannah type with Eucalypts and annual grasses.

T. pungens is the only resinous species among these discussed in this paper. The gum is used by natives for many purposes, *e.g.*, for fastening axe or spear heads to their shafts. So highly is it valued by the uncivilised tribes that it is an important item in bartering and even serves as a form of currency. It is believed that the seeds of a number of species are eaten.

HISTORY AND LIMITATION OF THE GENUS.

Triodia was described by Robert Brown in *Prodromus Florae Novae Hollandiae* p. 182: 1810. The name refers to the tridentate character of the lemmas. Bentham (*Benth. et Hook. F. Gen. Pl.* iii. 1175, 1883) and Hackel (*Engl. u. Prantl., Nat. Pflanzenf.* II Abt. 2. 68) took a wide view of the genus and included certain North American species. However, Stapf in his arrangement of the material in the Kew Herbarium (Hubbard in *Hook. Icones Pl.* Vol. iv. t. 3336, 1937) restricted the name of the Australian species and placed most of the American material in *Tridens*. This is a much more satisfactory arrangement. The lemmas in the American material are definitely three nerved and the outer nerves are more or less marginal. In the Australian species the nerves are in three groups of three or more, each group ending in the lobes and where the group is reduced to a single nerve it is not uncommon to find vestiges of nerves at the base. There is also a tremendous difference in the general habit of the two sets of species. While the American species are small tufted grasses the Australian ones are large tussocks with rigid, pungent pointed leaves. The odd geographic range must also be considered. There is a general resemblance between the habitats the two genera occupy.

Brown described four species of which *T. pungens* is the type for the genus. None of the type material was collected in Western Australia. Bentham (*Fl. Austral.* vii. p. 605: 1878) however, had the use of a larger amount of material and he listed *T. pungens* and *T. microstachya* for this State as well as his own species *T. Cunninghamii*. Concerning the first of these Hubbard (*Hook. Ic. Pl.* Vol. iv., t. 3336, 1937) has declared that the western material represents a distinct species. Nevertheless the author, as a result of field work, is convinced that the variations existing bridge the gap of the eastern material and definition, even as a variety, is not possible. This decision is supported by the agreement in foliar anatomy. *T. microstachya* is reported for the North-West Coast owing to a specimen collected by Cunningham. This specimen was seen, by the author, while at the Kew Herbarium in 1940 and it represents

a distinct species. It is described herein as *T. angusta*. *T. Cunninghamii* Benth. is not a satisfactory species. It was based on a specimen collected by Cunningham in the Cambridge Gulf, on the extreme northern coast of Western Australia. The specimen was seen at Kew and consisted of a few bare culms and a rather battered panicle most of whose glumes were empty. Neither the description nor the key characters are sufficient to distinguish it from *T. pungens*. Specimens collected on the 80-mile Beach by the author agree closely with the description but, with others, they grade into *T. pungens*. Bentham's name is accordingly regarded as a synonym in this paper.

Brown's species *T. procera* and *T. microstachya* were collected on the Upper Victoria River by Mueller. Gardner (Enum. Pl. Aust. Occ. 1930) accepted these as Western Australian. However the locality belongs to the Northern Territory so pending their collection in this State they cannot be included in this paper. Brown's remaining species *T. irritans* was also recorded for the State by Gardner (l.c.) who has collected it from several localities.

T. Mitchellii Benth. was recorded by Gardner (l.c.). However Queensland material, which had been compared with the type material, was made available through the courtesy of Mr. S. T. Blake, of the University of Queensland. This showed that our specimen was not *T. Mitchellii* but a variation of *T. pungens*.

Other species which have been described since the publication of the Flora Australiensis include *T. Baselowii* Pritzel (Fedde, Repert. xv. 356: 1918), *T. lanigera* Domin (Journ. Linn. Soc. Lond. xli. p. 278: 1912) and *T. longiceps* J. M. Black (Trans. Roy. Soc. S. Aus. liv. 59: 1930). The most recent publication is *T. Wiseana* C. A. Gardner (Journ. Roy. Soc. W. Aust. xxvii. 166: 1942).

T. intermedia Checl (Svensk Vet-Akad. Handb. U.S. lii. No. 10. 4. 1919) does not belong in this genus.

Four new species are described herein.

GENERIC DESCRIPTION.

Spikelets arranged on capillary or short peduncles or more or less sessile and secund on lateral branches of the panicle. Spikelets ovate to linear, 3-20 florets of which the upper two or three are empty and sterile. *Glumes* equal or almost so, scarious or indurate; 1-13 nerved; obtuse, acute, acuminate or aristulate; nerves often obscure; glabrous or scabrid. *Lemmas* tridentate with nerves in three groups each consisting of three to seven nerves or reduced to three nerves with or without vestiges at their bases. The entire portion scarious, hardened or becoming yellow horny-indurate, glabrous or pubescent. The lobes either mere indentations of the apex, in which case the midlobe may be formed of the prolongation of the central nerve, or there may be three scarious or rigid lobes as long as or longer than the entire portion. In the former group the nerves are distinct in the entire portion of the lemma, in the latter they are very obscure in the entire part and conspicuous in the lobes owing to associated strands of chlorenchymatous tissue. *Palea* shorter than the lemma, usually about as long as the entire portion; the nerves may be scabrid and prominent or with a thin membranous wing. *Lodicules* two, euneate or obovate. *Stamens* three. *Anthers* oblong or lanceolate, in some species dehiscing through subapical slits.

Perennial, xerophytic tussock-forming grasses. The tussocks may be up to two metres in height and the same in diameter. The growth form may be discoid, pyramidal or annular due to the dying away of the central portion.

The leaves appear terete owing to the folding together of the two upper or adaxial surfaces. In the field the leaf blade is not closed so that it appears v-shaped in cross section. In herbarium specimens the blades are closed so that they appear u-shaped in cross section. The blade may be glabrous, glaucous, or pubescent. It is pungent pointed in all western species. The ligule is a row of short hairs across the whole of the top of the sheath. Since the blade is narrower than the sheath there is a ridge, left on either side of the base of the lamina, which may become auriculate and which usually bears hairs longer than those of the ligule. Sheaths are glabrous, resinous or pubescent. Panicles are erect with branches spreading at anthesis.

Bentham refers to the glumes as keeled but most of the western material have glumes either rounded or very slightly keeled. One mistake commonly made in connection with this genus is that the leaf is described as convolute. As will be seen by the above description this is not the case. References to open and narrow panicles are of little use since at anthesis all western species, at least, spread their branches out at right angles to the main rachis. The spreading is due to a small swelling which appears at the base of each branch. In practically all herbarium material the branches have returned to the erect position.

The closest affinity is with *Plectrachne* Henr. This genus is distinguished from *Triodia* because of its awn like lobes to the lemmas. In view of the variation already present within *Triodia* this seems an inadequate feature on which to base a generic distinction.

Other affinities are with *Astrebla* and *Danthonia*.

KEY TO THE WESTERN AUSTRALIAN SPECIES.

Lobes of lemmas with conspicuous nerves and as long or longer than the entire portion where the nerves are obscure.

Lobes of the lemmas scarious. Leaf sheaths not resinous, more or less woolly pubescent

Lateral lobes of the lemmas obtuse *Basedowii*

Lateral lobes of the lemmas acuminate *lanigera*

Lobes of the lemmas rigid, erect or spreading.

Leaf sheaths resinous *pungens*

Lobes of lemma short (except in *T. Wiseana*). The nerves visible, under a lens, in both the base and the lobes.

Lower glume with three to seven nerves. Lowest lemma 5-8 mm. long.

Lateral lobes of the lemmas acute. Nerves of the palea winged.

Lobes of lemma nearly as long as entire portion. Sheath orifice with stiff glistening hairs 4-5 mm. long.

Leaves not glaucous *Wiseana*

Lobes of lemmas short. Sheath orifice with short woolly hairs. Leaves glaucous *brizioides*

Lateral lobes of the lemmas obtuse. Nerves of palea not winged *irritans*

Lower glume one nerved. Lowest lemma
2-4 mm. long

Spikelets pedunculate. Nerves of the palea
winged.

Lemmas thin, scarious. Glumes obtuse *Fitzgeraldii*

Lemmas indurate. Glumes acute or
acuminate *longiceps*

Spikelets sessile. Nerves of palea not
winged. Glumes acuminate or aristulate.

Lemmas glabrous or with few hairs.
Sheath orifice without auricular ap-
pendage. Leaves glaucous *angusta*

Lemmas pubescent on back and along
margin. Sheath orifice with fringed
appendage. Leaves not glaucous *secunda*

SPECIES.

Triodia Basedowii *Pritzelt* in *Fedde, Repert* xv. 356 (1918).

This species differs from *T. lanigera* Domin in the obtuse lateral lobes of the lemmas, the membranous palea and more obtuse glumes. It may be distinguished from *T. pungens* R. Br. by the woolly not resinous leaf sheaths.

It forms a dense tussock which, owing to the death of the older central parts, may become annular or crescentic. *Culms* erect or more or less ascending; internodes short, branches at the upper nodes. *Leaves* rigid, sheaths woolly-tomentose, especially towards the junction with the lamina, sometimes becoming almost glabrous; ligule a row of woolly hairs shorter than the tomentum of the auricular ridges, the latter hairs continued onto the base of the base of the "petiole"; the lamina is conduplicate, pungent pointed, minutely striate owing to ridges of tissue developed above the nerves, glabrous, 5-25 cm. long, 1.5 mm. wide, the petiole-like base 2-4 mm. long. *Panicle* narrower and shorter than in *T. lanigera*, with fewer spikelets; 8-12 cm. long. *Spikelets* spreading and truncate, pedunculate on the short panicle branches. *Glumes* enclosing the lemmas and almost as long as the spikelet, lanceolate or oblong, obtuse or shortly acute, membranous and becoming scarious, 9-13 nerved, the central nerve reaching the apex, equal in size, 6-10 mm. long, 3-4 mm. wide, minutely scabrid and slightly ciliolate towards the apex or quite glabrous and entire. *Lemmas* 5-8 per spikelet, the lower 3-5 fertile and hermaphrodite, lateral lobes obtuse, central lobe more or less acuminate, lateral lobes 4 mm. long, central lobe 5 mm. in the lowest floret, whole lemma softly pubescent and the margins of the lobes ciliolate. *Palea* obovate or oblong, the apex incurved over the floral organs, minutely pubescent, nerves scabrid, texture membranous. (Pl. I., fig. 1.)

So far as is known this is a useless species like *T. lanigera*. It is wide spread in the southern north-west and arid interior to the South Australian border.

Distribution.—Lake Way Station, Wiluna, *Melville* (*Burbidge* No. 451); north-east of Wiluna, *Stewart* (*Burbidge* 446); 60 miles east of Meekatharra, *Gardner*, 2367; Sandstone, *Gardner*; locality unknown, *Hann*, 1903.

Triodia lanigera *Domin* in *Journ. Linn. Soc. Lond.* xli. 278: 1912.

Differs from *T. pungens* in the scarios (not rigid) lobes of the lemmas, the scarios, many nerved glumes, and the glaucous foliage with woolly, not resinous, sheaths.

Coarse perennial tussock-forming grass. *Culms* ascending, many noded, branching at the upper nodes, internodes short, more or less woolly, especially immediately below the nodes. *Leaves* glaucous, the sheaths much longer than the internodes, tomentose or becoming glabrescent in the older parts; ligule a row of short hairs, the tomentum of the sheath continued on to the petiole-like base of the lamina. The lamina rigid, pungent pointed, conduplicate, glabrous on the abaxial and scabrid on the adaxial surface, striate under a lens, 10–20 cm. long, 2 mm. wide, the petiole-like base 3–5 mm. long and narrower than the lamina which is much narrower than the sheath. *Panicle* erect, loose, spreading at anthesis, branches with woolly hairs at their bases. *Spikelets* cuneate with spreading florets, shortly pedunculate. *Glumes* lanceolate or oblong, rounded on the back, scarios, 9–13 nerved, apex acute, acuminate or shortly aristulate, the margin minutely ciliate, 8–12 mm. long, 4 mm. wide. *Lemmas* commonly 6–8 of which the lower 4–6 are hermaphrodite, the rest with anthers or empty; sharply divided into an indurate horny base 2–3 mm. long, in which there is little or no indication of the nerves, and the three scarios lobes each of which is traversed by a group of 3–5 nerves, the central nerve of each group reaching to the apex of the lobe, the nerves bounded by a narrow strip of chlorenchymatous tissue; lobes acuminate and minutely ciliate, the lateral ones 4–6 mm. long and the central one 7–10 mm. in the lowest lemma; the whole lemma softly pubescent. *Palea* obovate or oblong, curved in over the floral organs, the base commonly indurate and the apex membranous, 3 mm. long in the lowest floret, the nerves ciliate and scabrid. (Pl. 1., fig 2.)

The spikelets are reminiscent of those of *Danthonia bipartita*.

This species is completely worthless to the pastoralist except for the possibility that the seedheads are occasionally sought by hungry stock. The rigid, pungent pointed, dry leaves are quite unpalatable. It is found in the arid summer rainfall areas of the State.

Distribution.—Between Ashburton and Yule Rivers. *Clement* (type seen at Kew Herbarium); Warralong Station, *Anderson* (*Burbidge* No. 447 and 453), also *Melville* (*Burbidge* 454) and *Burbidge* 1222 (the last near Shaw River); Abydos Station south-west of Marble Bar, *Stewart*; South of Ashburton River, *Gardner* 6233; between Caseoynne and Fortescue Rivers, *H. S. King*; Mia Mia Station, Minilya River, *Gardner* 3203; Minilya River, *Gardner* 3209, 4109, 6219; Lyndon near Carnarvon, *Meadley* M77.

Triodia pungens *R.Br.* in *Prodr. Fl. Novae Holl.* p. 182: 1810; *C. E. Hubbard* in *Hook. Icones Pl.* Vol. iv. pt. ii. t. 3336; *T. viscida* *Roem et Schult. Sys. Veg.* ii. 599: 1817; *Festuca viscida* *F. Muell. Veg. Chath. Isl.* 59: 1864; *Triodia Cunninghamii* *Benth.* in *Fl. Austral.* vii. 606: 1878.

Perennial tussock grass. The growth form is very variable and is further discussed below. *Culms* glabrous, erect or ascendent or forming long stolons with tufts of short erect culms at the apex. *Leaves* conduplicate, the blade more or less open when growing; sheaths coated with a resinous secretion. Former descriptions refer to the leaves being resinous. In all specimens examined, both in the herbarium and in the field, it was found that the resin is only present on other portions of the plant where they are in contact with

the sheaths. At the orifice of the sheath there are long hairs on the auricular ridge and these are usually matted together with the resin. The ligule is a row of short hairs extending right across the inner face of the top of the sheath. The lamina is narrower than the sheath. The petiole-like base is shorter than in most species. The margin of the lamina is scabrid and the apex pungent but the point is not rigid as in "Buck Spinifex." *Panicle* pyramidal at anthesis but in most herbarium material the branches erect and the spikelets clustered together, variable in size and from 10-40 cm. long. *Spikelets* linear to ovate (in spikelets with fewer lemmas), with more or less imbricate lemmas, shortly pedunculate or almost sessile along the panicle branches, 4-11 florets. *Glumes* lanceolate, ovate or oblong, concave, becoming indurate; nerves 5-7 usually obscure; glabrous or minutely scabrid; the apex acute, shortly aristulate or ragged. *Lemmas* divided into an entire, indurate basal portion which covers the floral organs and three rigid, erect or spreading acuminate lobes which vary from as long as to longer than the basal part; the latter apparently without nerves, pubescent at the base and up the middle of the abaxial surface; the lobes with 3-5 nerves each bounded by a green strip of chlorenchymatous tissue, and a thin scarious margin which is minutely ciliolate. *Palea* elliptical, slightly longer than the entire portion of the lemma and usually curved over the floral organs, apex ciliate, nerves narrowly winged. *Anthers* oblanceolate, dehiscing from sub-apical slits. *Caryopsis* oblong. (Pl. I., fig 3.)

Despite the wide variation in the growth form and in the dimensions of the parts of the spikelets, the author, after due consideration of both herbarium material and field information has come to the conclusion that varieties in the taxonomic sense cannot be distinguished. It has been found that spikelet variations cannot be correlated with differences in habit. Thus growth forms with quite different values as feed cannot be recognised simply from a herbarium specimen. The differences between the majority of the material are differences of degree only, *e.g.*, relative length of spikelets, relative length of glumes to lemmas, etc. Again, Hubbard's view (Icones Pl. iv. ii. t. 3336: 1937) that the western material represents a distinct species, has been disagreed with for the same reason. The western specimens have a more heavily indurate base to the lemma, which is usually yellow and horny but intermediates occur. The spikelets in our material have more florets but this has been found to depend partly on the vigour of the plant, which is related to the habitat or to the time of year in which the panicle develops, which again is a matter of habitat. Apart from field notes more than a hundred separate collectings were available on which to base the conclusions expressed herein.

Nevertheless the growth forms that are evident in the field are described below so that some idea of the variation of the species is made available. All these forms and less distinct ones, not described, have their significance for the pastoralist. The grazing animals (sheep) show definite preferences for some forms. This is a result not only of different food values but also because of more direct reasons for palatability, *e.g.*, the leaves are less resinous, or less pungent, or less scabrid and fibrous. The habitat effects the form to a certain extent though broadly speaking there are few major soil alterations throughout the area over which this species is distributed (except 80 Mile Beach country).

The forms are divided into two groups:—(a) forms with a dense cushion-like tussock which does not develop long runners, (b) forms with a tussock formed chiefly by loosely tangled stolons or runners which develop semi-independent tussocks at their ends. The former group is the larger.

Group (a) includes the following :—

(i) A large domed tussock up to a metre or more in height and about the same in diameter. The general habit is dense. The sheaths are very resinous and on older culms the resin is dried to a white incrustation. The leaves are dark green, the blades about 20–25 cm. long and scabrid along the margins which are spread apart. The panicle is large and 50–70 cm. higher than the tussock. The panicle branches are long, the lower ones bearing 6–10 spikelets, each of the latter bearing more than six florets.

This is a coarse form which is eaten in the young stages. Later the sheep turn to it only in case of necessity. It is common on the plains along the De Grey River and southwards to Marble Bar.

(ii) Dark green tussock smaller than the preceding to which it approaches closely. The leaves are usually very scabrid but there are plants with smooth margined leaves. It differs in lacking the white incrustation on the older portions, in its smaller size and its smaller panicle whose branches bear 4–5 spikelets. It is a very resinous form.

It is, perhaps, the most common form of soft spinifex. It was found by the author on all inland stations visited. It is, in some places, subject to variation due to habitat. For example, at Mount Edgar Station, south-east from Marble Bar, it grew as a small compact tussock on the higher rocky ground and as a more vigorous larger tussock in the hollows. It is eaten in the young stages and also later except where there is a high proportion of dead leaves.

(iii) Low flat tussock about 30 cm. high and up to 2–3 metres in diameter. The central or older portion commonly dies off. In this case the dried culms disintegrate and blow away. The panicle is short, 10–20 cm. long and compact, *i.e.*, the branches arise close together.

This form was well developed in the country adjacent to the Coongan River, a tributary of the De Grey. It appeared to be fairly palatable to sheep.

(iv) Small dense tussock 30–40 cm. high with very yellowish green leaves. This was an easily recognisable form in the field. The leaf blades are softer than in other forms and the blades are closed so that the leaf appears terete. The panicle is again short and only about 20–30 cm. higher than the tussock. The spikelets are very squat and ovate.

Common along the De Grey plains. It occurs in small areas amongst (i) and (ii) from which it can be easily separated.

(v) Hill Spinifex. The tussocks on the rocky slopes are very short culmed. The leaf blades are variable and in the gullies may grow to more than 30 cm., though usually they are 15–20 cm. long. The panicle has fewer spikelets, which are narrower and with the lemmas more imbricate. The glumes are rather scarious, not indurate, and the lobes of the lemmas are shorter than in the plains forms. The plants are less resinous.

Found on all hilly country in the Pilbara area. It is apparently an ecotype, being restricted to its habitat. The hills on which it grows are stony, arid, and barren.

(vi) Coastal Spinifex. The plants are characterised by their long leaves, 30–50 cm. long, thin and wiry as in (iv). The general habit is a dense central butt with a loose mass of surrounding culms. The panicle has spikelets which are consistently smaller than those of the inland forms. The smaller

ones agree so closely with those described for *T. Cunninghamii* Benth., that this name is regarded as a synonym of *T. pungens*. There are, however, intermediate sizes so that it is not possible to make a variety.

This form is only found on the grey sand and loam soils of the coastal plain along the 80 Mile Beach.

Group (b) has two forms:—

(vii) Runner Spinifex. Practically the whole of the plant is made up of long stolons. In one place a tussock was seen which was more than three metres in diameter but the possible range varies down to a metre. The panicle has no very special characteristics except that the glumes are usually longer than the three lowest lemmas instead of as long as the lowest lemma but this may not be constant. The leaf blades are scabrid and open when growing.

This form was found in rather small patches all through the plains country along the De Grey River. It grows on country adjacent to the rivers but not actually along the banks. It appears to set very little seed and does not regenerate easily like the first four forms.

(viii) Pindan Spinifex. The growth form is very like that of (vii) but there is a cushion tussock with radiating stolons. It is fairly resinous and there are no special panicle features.

This type is mentioned as it occurs in a different ecological community. Spinifex pindan is an *Acacia*—tussock grass association. Either *Triodia* or *Plectrachne* is found in the lower stratum. Spinifex pindan occurs in the "desert" country inland from the coastal plain of the 80 Mile Beach and to the north of the De Grey River. Form (viii) appears to be less palatable to sheep than is (vii).

Distribution.—Anna Plains, *Burbidge*; Nalgi, *Burbidge*; Wallal Downs, *Burbidge*; Pardoo, *Burbidge*; De Grey Station, *Burbidge* also *Anderson*; Poondanah Siding, *Burbidge*; Port Hedland, *Fitzgerald* 64, 1558; Shaw River, *Anderson* (*Burbidge* No. 465); Mulyee Station, *Anderson* (*Burbidge* 463); Coongan Station, *Anderson* also *Melville* also *Burbidge*; Warralong Station, *Anderson*, also *Melville* also *Burbidge*; Gorge Range, *Burbidge*; Soda Creek, on Coongan Station, *Burbidge*; Muccan Station, De Grey River, *Burbidge*; Kitty's Gap, *Burbidge*; Eginbah Station, *Burbidge*; Marble Bar, *Burbidge*; Mount Edgar Station, *Burbidge*; Stony Hills to south of Mount Edgar, *Burbidge*; Meentheena Station, *Blair*; Dampier Archipelago, *Walcot*; Nichol Bay, *Sewell*; Roebourne, *Polak*; Warambie Station, Roebourne, *H. G. Meares*; Ashburton River, *Morrison*; Cane River, *Gardner* 3074, 6238; Beadon, *Gardner* 3069, Port Sampson, *Gardner* 1638.

Triodia Wiseana *C. A. Gardn.* in *Journ. Roy. Soc. W. Aust.* xxvii 166: 1942.

This species can be identified by the peculiar hairs developed on the auricular ridge, at the top of the leaf sheath, and along the margin of the lower portion of the lamina. The lemmas have three acute lobes and the nerves are visible in the basal portion as well as in the lobes. The paleas have a well developed wing on each nerve.

Culms ascending in dense tussocks; internodes short, glabrous and smooth; branching from the upper nodes. *Leaves* rigid, divaricate, with glistening hairs 4–6 mm. long developed on the auricular ridge at the top of the sheath and along the lower part of the lamina. The hairs arise in

groups from small swellings. The ligule is a row of short hairs. The lamina is conduplicate, minutely striate, pungent pointed, 10–20 cm. long, 2 mm. wide. *Panicle*. 6–12 cm. long, loose, and open with spikelets on scabrid capillary branches. *Spikelets* 8–10 mm. long. *Glumes* lanceolate or oblong, apex acute or almost aristulate, commonly trinerved but sometimes having axillary lateral nerves, subequal, glabrous, indurate, 4–5 mm. long. *Lemmas* imbricate, 3–9, indurate, lanceolate with three rigid acute or acuminate lobes from half to nearly as long as the entire portion; three groups of three nerves continued almost to the base; with a row of hairs up the centre of the abaxial surface and others along the margins; lowest lemma 4–6 mm. long. *Palea* oblong 3–4 mm. long, membranous or scarious, nerves winged. The margins of the wings usually protrude slightly in the spikelet.

Gardner's specimen was, unfortunately, rather immature. The peculiar hairs on the leaves, however, showed it to be a distinct form.

Distribution.—Mount Margaret Pass, Hamersley Range, *Gardner* 3129 (type); near Mount Rica, *Gardner* 6422.

***Triodia Wiseanna* var. *brevifolia* N. T. Burbidge var. nov.**

Laminae brevae, 5–9 cm. longae, 1–1.5 mm. latae. *Lemmata* indurata, lobi acuminati, rigidi, divaricati, 3-nervis.

Differs from Gardner's typical form in its shorter, narrower leaves with the marginal and auricular hairs less prolifically developed. These hairs are not conspicuous in the field. Apparently when growing they lie parallel to the margin. It is only in dried material that they stand out. The lemmas are more deeply lobed so that the appearance approaches that of *T. pungens*. However, the nerves are clearly visible in the base of the lemma. (Pl. II., fig. 4.)

The variety, like the typical form, is found on stony ground which, in the Pilbara area, means the arid slopes of the hills.

Distribution.—Anna Plains Station, 80 Mile Beach, *Burbidge* 1438; Muccan Station, De Grey River, *Burbidge* 994; between Kitty's Gap and Eginbah Station, *Burbidge* 995; Dingo Point, Eginbah Station, *Burbidge* 1044; between Eginbah and Marble Bar, *Burbidge* 1062; Mount Edgar Station, south-east from Marble Bar, *Burbidge* 1126; Nullagine Road south from Mount Edgar, *Burbidge* 1150, 1152 (type), 1172, 1176; Red Hill north of Ashburton River, *Gardner* 6371.

***Triodia brizioides* N. T. Burbidge sp. nov.**: affinis *T. irritanti*, a qua lemmatibus acute lobatis, glumis aristulatis, laminis glaucis differt.

Gramen perenne, dense caespitosum. *Culmi* ascendentes, nodis superioribus ramosi, multis nodis, glabri, laeves. *Foliorum vaginae* induratae, laeves, glabrae vel sparse tomentosae, pallidae vel stramineae, ligulae ad seriem cilliorum redactae; orificia tomentosa; laminae angustiores vaginarum, breviter petiolatae, rigidae, glaucae, divaricatae conduplicatae, 5–12 cm. longae, 1.5 mm. latae explanatae; apices pungentes. *Paniculae* diffusae, 5–10 cm. longae; rhaehis scabra, spiculae pedunculatae, bases pedunculorum villosae, pedunculi 6–15 mm. longi, scabri. *Spiculae* lateraliter compressae, lineares vel oblongae, pallidae, 10–20 mm. longae, 6–8 mm. latae. *Anthoecia* 7–10. *Glumae* oblongae, concavae, aristulatae, aequales, glabrae, scariosae, 6 mm. longae, 3 mm. latae, 3-nervis, apices ciliolatae. *Lemmata* lanceolata vel ovata, 9-nervis, basi pubescentis, margine barbata; infima 5–7 mm. longa;

trilobata ; lobi acuti, ciliolati, subaequales vel medii longiores, nervosi. *Paleae* lineares 5-6 mm. longae, basi pubescentes, bicarinatae ; alatae. (Pl. II., fig. 5.)

This grass forms a very dense hemispherical, greyish tussock 40-50 cm. in diameter. It prefers rocky slopes and is found on arid hills in the Pilbara district. It is easily distinguished from *T. irritans* by the glaucous leaves, the loose panicle in which the comparatively few spikelets are apt to hang down resembling those of *Briza maxima*, the acute lobes of the lemmas and the winged nerves of the paleas. These wings commonly protrude beyond the margin of the lemma in the spikelets.

The species is of no pastoral importance.

Distribution.—Gorge Range (between Shaw and Coongan Rivers), *Burbidge* 792 (type !); Kitty's Gap (between Coongan River and Bamboo Creek), *Burbidge* 979 and 984.

Triodia irritans R.Br. in Prodr. Fl. Novae Holl. 182: 1810; *Festuca irritans* F. Muell. Veg. Chath. Isl. 59. Fragm. viii. 129: 1874.

A perennial grass forming dense tussocks. *Culms* ascending, quite glabrous, internodes short, branching from the upper nodes. *Leaves* glabrous ; ligule a row of short hairs, the auricular ridges of the sheaths very short and bearing hairs longer than those of the ligule ; blades conduplicate, 8-16 cm. long, very pungent pointed. *Panicle* 10-20 cm. long with spikelets on capillary peduncles along the branches ; the spikelets 10-18 mm. long, 3-8 mm. wide. *Glumes* 6-9 mm. long, subequal, scarious or becoming indurate, 1-5 nerved (usually the lower glume three-nerved and the upper five-nerved), the mid nerve prominent, lanceolate, acuminate or acute, minutely scabridulous. *Lemmas* 5-10, the lower 3-4 fertile, lanceolate with a ragged obtuse apex composed of three very short lobes of which the lateral ones are membranous and the medial one a prolongation of the mid-nerve. The medial lobe may be longer or shorter than the lateral lobes. There are nine nerves in groups of three, each being associated with a lobe, the nerves visible almost to the base of the lemma, which is clothed on the lower abaxial and marginal surface with silky hairs. The lowest lemma 5-8 mm. long. *Palea* linear or slightly oblanceolate, obtuse, shorter than the lemma or almost as long, glabrous or pubescent in the lower half, the nerves scabrid. (Pl. 2, fig. 6.)

A "Buck Spinifex" which is associated with the arid portions of the southern interior. The Kalgoorlie specimen has a narrower panicle and smaller spikelets than the other specimens but seems hardly distinct enough to separate as a variety. Further collections may serve to elucidate the point.

Distribution.—Meekatharra, C. A. Gardner ; Coorow, Gardner ; 20 miles east of Mount Holland, Gardner ; Kalgoorlie, Gardner ; near Fraser Range, Gardner 2851a.

Triodia Fitzgeraldii N. T. Burbidge sp. nov. ; *Triodia Fitzgeraldii* C. A. Gardner ms. ; affinis *T. longiceps* J. M. Black sed spiculis minoribus, lemmatibus scariosis, lobis acutis, vaginarum marginibus hirsutis differens.

Gramen perenne, caespitosum. *Culmi* erecti, rigidissimi, nodis superioribus ramosi, glabri, laeves, multis nodis ; internodia brevia. *Folia* rigida ; vaginae imbricatae, pubescentes vel glabrescentes, marginibus et orifice hirsutis ; ligulae ad seriem ciliorum redactae ; laminae angustiores vaginarum, rigidae, conduplicatae, glabrae, minute striatae, breviter petiolatae, 9-20 cm.

longae, apicibus pungentes. *Paniculae* contraetae, angustae. *Spiculae* breviter pedunculatae, lateraliter compressae, lineares, 4-6 mm. longae, 3 mm. latae, pallidae. *Anthoecia* 4-6. *Glumae* oblongae, obtusae, laeves, subaequales, marginibus minute ciliolatis, 1-nervo, 2.5-3 mm. longae. *Lemmata* lanceolata, scariosa, 3-nervis, 3 mm. longa, basi villosa, apicibus trilobata; lobi acuti, nervosi, minute ciliolati, subaequales. *Paleae* oblongae vel lanceolatae, 2 mm. longae, nervis anguste alatis. (Pl. 3, fig. 7.)

This species lies between *T. longiceps* J. M. Black and *T. microstachya* R.Br. It differs from the former in its smaller spikelets, scarious lemmas with acute lobes and the ciliate, pubescent leaf sheaths and from the latter in its one-nerved glumes, basally pubescent lemmas and narrowly winged nerves of the paleas. Its distinctive character was pointed out to the author by Mr. C. A. Gardner who suggested naming it after its discoverer. It is known from the type specimen only.

Distribution.—Dillon's Springs, East Kimberley, *W. V. Fitzgerald* 1643 (type!).

Triodia longiceps *J. M. Black* in *Trans. Roy. Soc., S. Aust.*, liv. 59: 1930.

A perennial grass forming large rather loose tussocks (up to four or five metres in diameter and 2-4 metres in height) and having long stolons extending beyond. Culms smooth and glabrous, branching from the upper nodes. *Leaves* very rigid, glaucous, the sheaths and blades glabrous or minutely puberulous and with very short cilia on the orifice of the sheath; ligule a row of short cilia; apex very pungent pointed. *Panicle* 20-50 cm. long, with the spikelets shortly pedunculate on the lateral branches which spread at anthesis. *Spikelets* linear, with 6-21 florets, 8-20 cm. long, 2.5-3 mm. wide, with the lemmas imbricate or spreading. *Glumes* lanceolate or almost ovate, glabrous, subequal 3.5-4 mm. long, with one slightly prominent nerve extending to the acute or acuminate apex. *Lemmas* lanceolate or ovate, 4 mm. long, indurate, glabrous or with a basal tuft of short hairs, the nerves reduced (from three groups of three each) so that only one nerve extends to each lobe but at the base of the lemmas the vestiges of the lateral nerves of each group are more or less developed; the apex with three very short, subequal, acute lobes in the Western Australian material though, in his description, Black says the lateral lobes are obtuse with a short mucro between. *Palea* 3 mm. long, oblong or lanceolate with prominently winged nerves, glabrous, the upper half usually free from the lemma and conspicuous. (Pl. 3, fig. 8.)

In the field the general habit approaches that of *T. angusta* but it is a coarser plant and the panicle is quite distinctive. Both species show a preference for the banks of water courses and flats liable to flooding. The chief affinity seems to be with *T. microstachya* from which it differs in the one nerved glumes and the winged, glabrous palea.

Distribution.—Pardoo Station, *Burbidge* 1519; De Grey Station, *Ander-son*, also *Burbidge* 1544; Warralong Station, *Melville* 28 and *Burbidge* 791; Muecan Station, *Burbidge* 911 and 965; Marble Bar, *Stewart*; Mount Edgar Station, south-east from Marble Bar, *Burbidge* 1066, 1067, 1129, 1192, 1138; Nullagine, *Melville*.

Triodia angusta *N. T. Burbidge* sp. nov., affinis *T. microstachyae* R.Br. sed glumis inferioribus 1-nervis, acuminatis, spicis angustioribus, linearibus, lemmatibus sparsim pubescentibus differens.

Gramen perenne, caespites late extensos densissimos formans et stolones elongatos emittens. *Culmi* divaricati, rigidissimi, glabri, laeves, simplices vel

basi ramosi, 6-12 nodis. *Foliorum vaginae* induratae, laeves, glaucae; ligulae ad seriem ciliorum redactae; laminae angustiores vaginarum, breviter petiolatae, rigidae, conduplicatae, apicibus pungentibus, marginibus ciliolatis, 12-20 cm. longae, 2 mm. latae explanatae. *Paniculae* contractae, anguste lineares, 15-20 cm. longae, 7 mm. latae; rhachis scabra, angulata; spicae simplices, breviter pedunculatae, anguste lineares. *Spiculae* sessiles, secundae, lateraliter compressae, oblongae vel lineares, angustae, biserratae, pallidae, 2 mm. latae, 4-5 mm. longae. *Anthoecia* 3-4. *Glumae* lineares vel lanceolatae, acuminatae vel aristulatae, scariosae, scabridulosae vel glabrae, nervis scabridis; inferior 1-nervo, 2-3 mm. longa; superior 3-nervis, 3-4 mm. longa. *Lemmata* lanceolata vel anguste ovata, membranacea, 3-nervis, 2.5-3 mm. longa; margines glabrae vel raro pubescentes; apices trilobatae; lobi nervati, erecti, acuti, lobi laterales paulum breviores quam medii. *Paleae* ellipticae, membranaceae, 3 mm. longae, nervis ciliolatis. *Lodiculae* 1 mm. longae. *Antherae* 2-2.5 mm. longae. *Caryopsis* O. (Pl. 3, fig. 9, a-f, fig. 11, a-b.)

In the field this species is readily distinguished from *T. secunda* by the glaucous foliage. It has a denser tussock being formed of a central tuft with radiating stolons. The stolons have terminal tufts of erect culms. The leaves have a very small auricular ridge which bears hairs about as long as those of the ligule proper. However, some material collected, by the author, at Shaw River had woolly sheaths while a specimen from Talga Gap, near Coongan railway siding, had very long hairs on the ridge. Since there is no special panicle difference which can be correlated with these leaf variations they are all included under the species. Apart from these exceptions the leaves and sheaths are glabrous in all specimens though the margins of the blades are commonly scabrid with minute teeth. The one nerved glumes serve to divide the species from *T. microstachya* R.Br., also the smaller narrower spikelets.

Cunningham's specimen from the "North-West Coast." which is listed under *T. microstachya* by Bentham in the Flora Australiensis, belongs to this species. It was identified by the author while at the Kew Herbarium in 1940.

The species is commonly referred to as Blue Buck. It is of no pastoral importance. It is a very common species and in the field, when panicles are missing, it may be confused with *T. longiceps*. It is usually found along the banks of rivers and creeks.

Distribution.—Coongan Station, *Anderson* (*Burbidge* 452 type ! and 445); Warralong Station, *Burbidge* 828; Shaw River, *Burbidge* 1216; Talga Gap near Coongan Siding, *Burbidge* 1051; Hills south of Mount Edgar, *Burbidge* 1151; Warambie Station, Roebourne, *H. G. Meares*; Sandstone rocks, Gregory's Gorge, Fortescue River, *Gardner* 6296; Karatha, west of Roebourne *Gardner* 626.

Triodia secunda N. T. *Burbidge* sp. nov., affinis *T. angustae* N. T. *Burbidge* sed spicis latis linearibus, lemmatibus divaricatis, lemmatum marginibus differens.

Gramen perenne caespitosum et stolones elongatos emittens. *Culmi* erecti vel prostrati, rigidissimi, nodis superioribus ramosi, glabri, laeves. *Foliorum vaginae* induratae, tenuiter, striatae vel laeves, glabrae, pallidae vel stramineae; ligulae ad seriem ciliorum redactae; auriculae erectae, fimbriatae; fimbriae ciliolatae; laminae angustiores vaginarum, breviter petiolatae, rigidae, virides, divaricatae, conduplicatae, 6-12 cm. longae, 2-3 mm. latae explanatae; apices pungentes, margines ciliolatae. *Paniculae* contractae, anguste lineares; spicae simplices, distantes, latae lineares, rhachi adpressae, 1-3 cm. longae. *Spiculae*

sessiles, secundae, biserratae, divaricatae, pallidae, lateraliter compressae, oblongae, 5 mm. longae, 4-5 mm. latae. *Anthoecia* 3-6. *Glumae* lineares vel lanceolatae, scabridulae, uni-nervatae, nervis scabris: inferior acuta vel aristulata, 3 mm. longa: superior trilobata, 4-5 mm. longa, lobus medius aristulatus, lobi laterales membranacei, acuti, breves. *Lemmata* lanceolata vel anguste ovata, membranacea, divaricata, tri-nervata, 3-4 mm. longa, basi pubescentia, marginibus barbata, apices trilobatae, lobi aequales, nervati. *Paleae* lineares, 3-3.5 mm. longae, basi pubescentes, nervi scabridi. *Lodiculae* 1 mm. longae. *Antherae* 2.5-3 mm. longae. *Caryopsis* O. (Pl. 3, fig. 10, a-f, fig. 11, c-d.)

The erect culms branch at the upper nodes, producing long prostrate stolons or short erect culms, so that when growing the plants often appear to be resting on stilts. The central mass of culms is surrounded by the radiating stolons which develop terminal groups of erect culms like those of the central portion. In this manner a single plant may cover several square meters in a diffuse growth about 30 cm. deep.

The leaves are a drab green when fresh. They are very pungent pointed. The sheaths turn a pale straw colour on the older stems. The auricular growths are quite characteristic of this species. Nothing like them is known. They are also remarkable because three marginal nerves on either side of the sheath extend into the auricles. The second panicle branches with their broad spikelets and fringed lemmas serve to distinguish this species.

The common name is "Running Buck" or "Bunch Buck." The species is of no pastoral value though there are reports that it has carried sheep through dry summers when there was nothing else available. It is usually found on flats or near drainage channels too diffuse to call creeks.

Distribution.—Coongan Station, *Anderson* (*Burbidge* 460 type!); Warralong Station, *G. F. Melville* also *F. Melville*.

It was observed by the author in other localities:—De Grey Station, Pardoo Station, along the Marble Bar-Port Hedland Railway between Carlindi and Poondanah Sidings and on low flats behind Port Hedland township. None of the plants carried panicles and no material was collected. The presence of the fringed appendage on the leaf sheath is, however, sufficiently characteristic to make the identification reliable.

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EXPLANATION OF PLATES.

PLATE I.

Fig. 1. *Triodia Basedowii*, (a) spikelet, (b) lower glume, (c) upper glume, (d) lemma, (e) palea from side, (f) palea from front. (all x5.)

Fig. 2. *T. lanigera* (x5). Lettering as above.

Fig. 3. *T. pungens* (x5). Lettering as above.

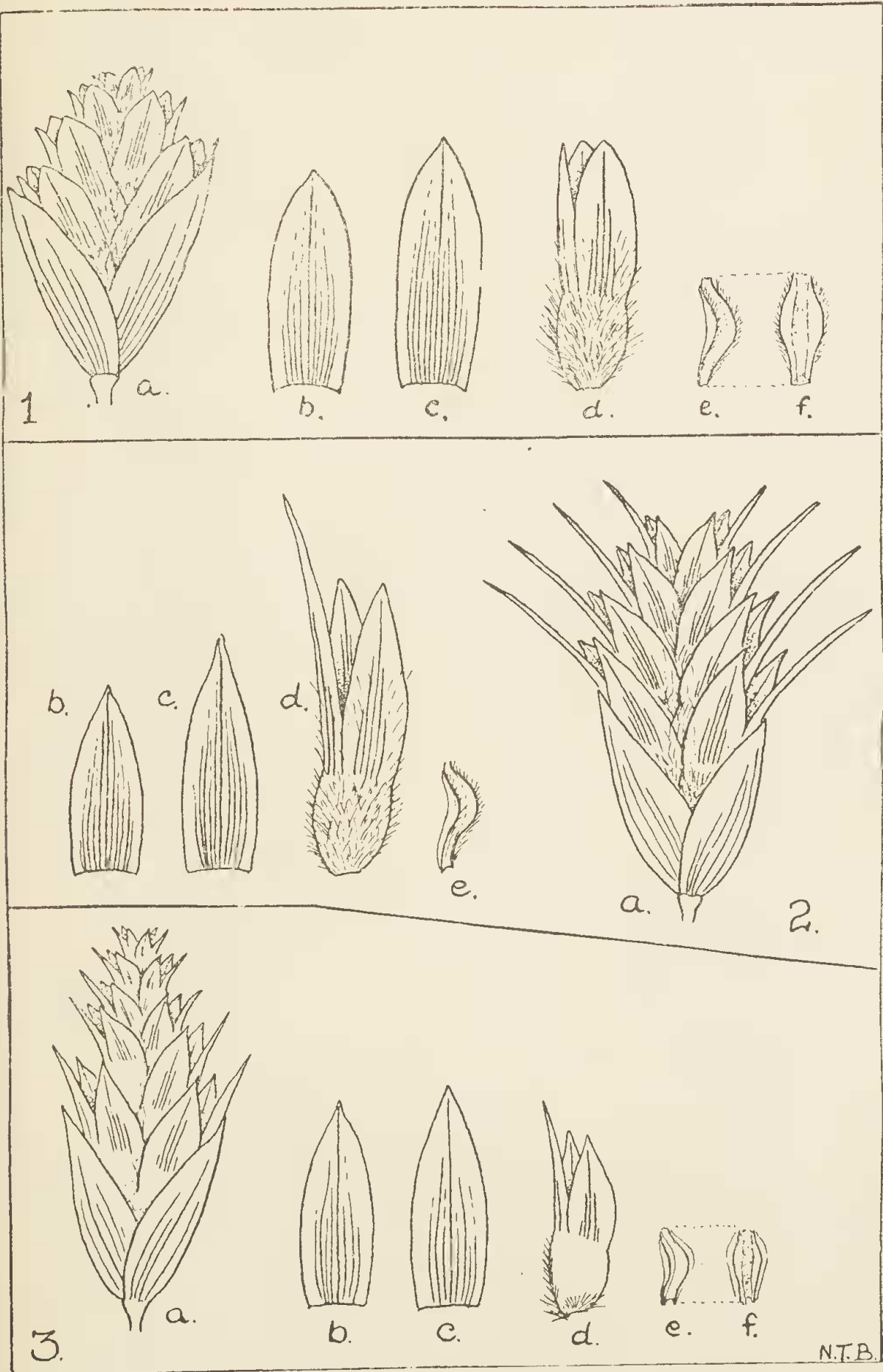


PLATE I.

N.T.B.

PLATE II.

- Fig. 4. *T. Wiseana* var. *brevifolia* (x5). Lettering as in Plate I.
Fig. 5. *T. brizioides* (x5). Lettering as in Plate I.
Fig. 6. *T. irritans* (x5). Lettering as in Plate I.

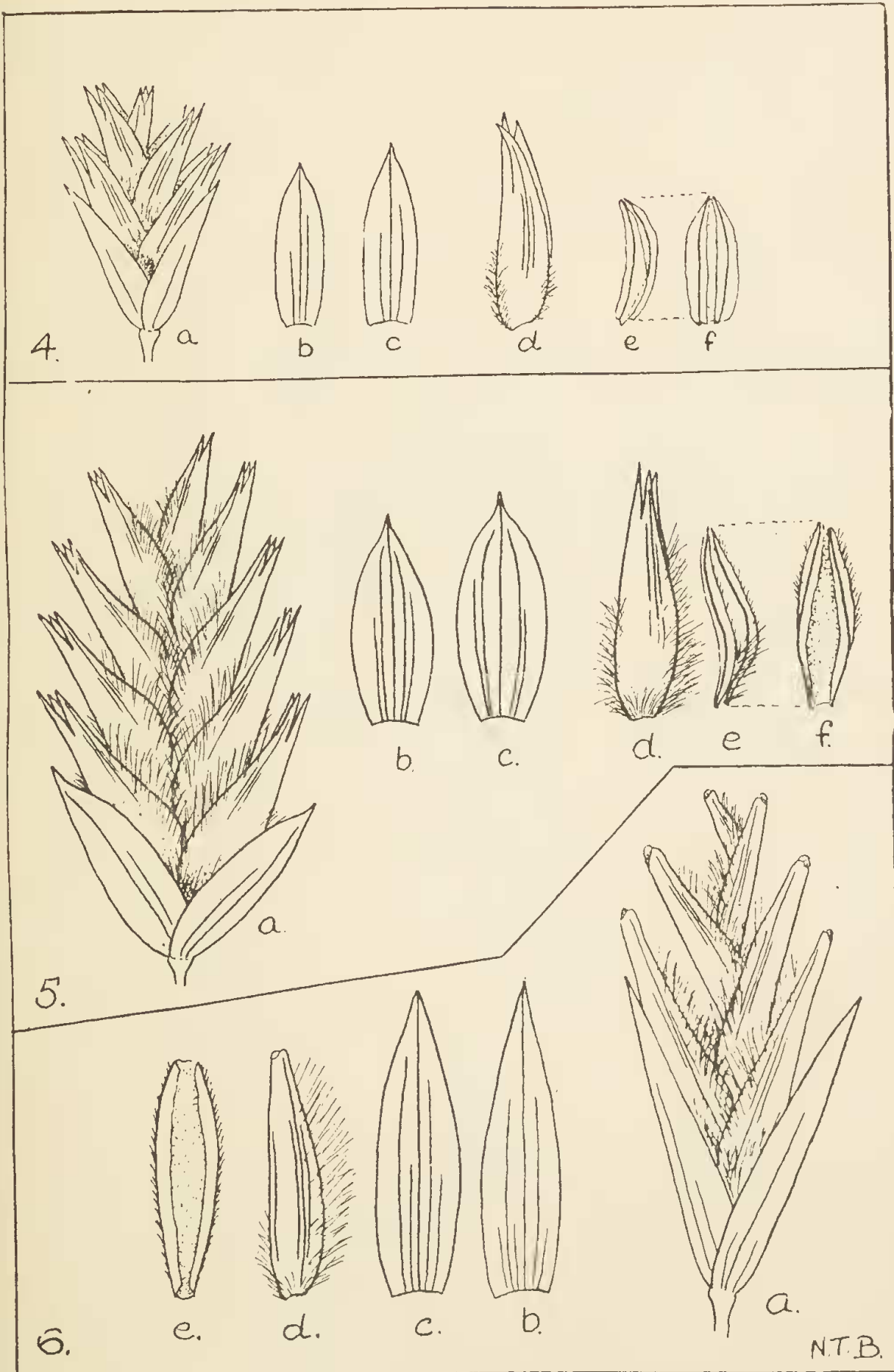
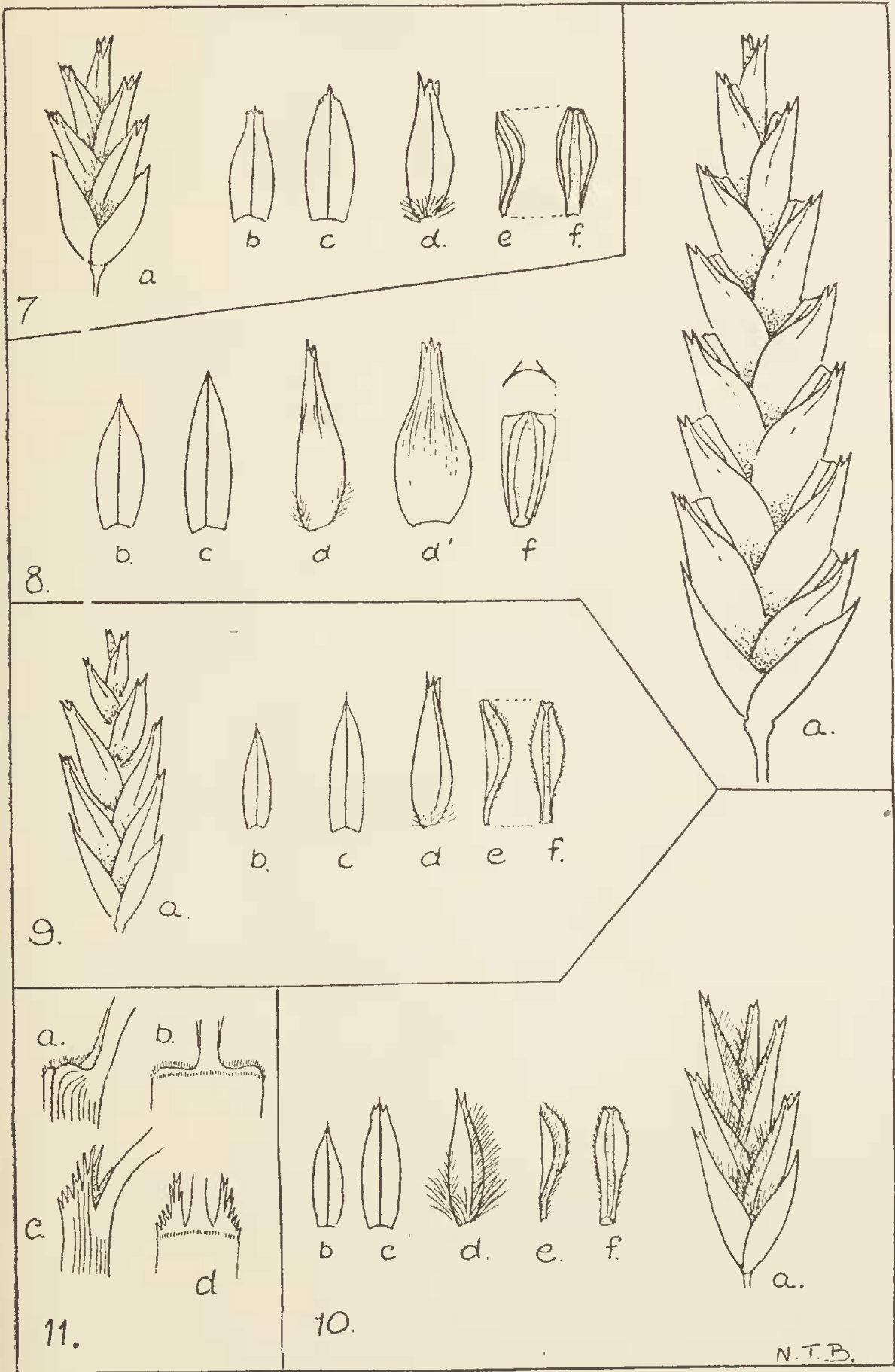


PLATE II.

PLATE III.

- Fig. 7. *T. Fitzgeraldii* (x5). Lettering as in Plate I.
Fig. 8. *T. longiceps* (x5). Lettering as in Plate I.
Fig. 9. *T. angusta* (x5). Lettering as in Plate I.
Fig. 10. *T. secunda* (x5). Lettering as in Plate I.
Fig. 11. *T. angus'a*, (a) orifice of leaf sheath from side (b) same from within showing ligule. *T. secunda*, (c) orifice with fringed appendage, (d) same from within to show ligule. (x5.)



N.T.B.

PLATE III.

